Active Networks

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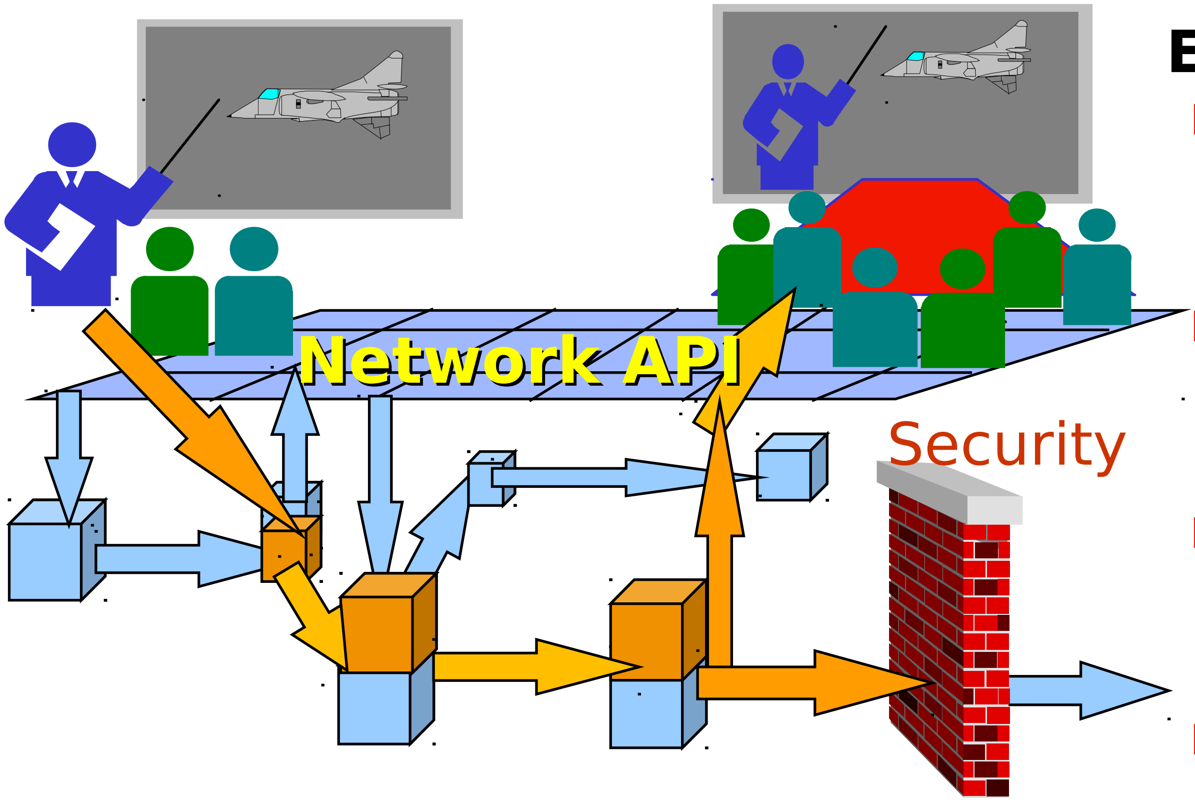
ACTIVE NETWORKS

DARPA

Network That “Turn on a Dime”



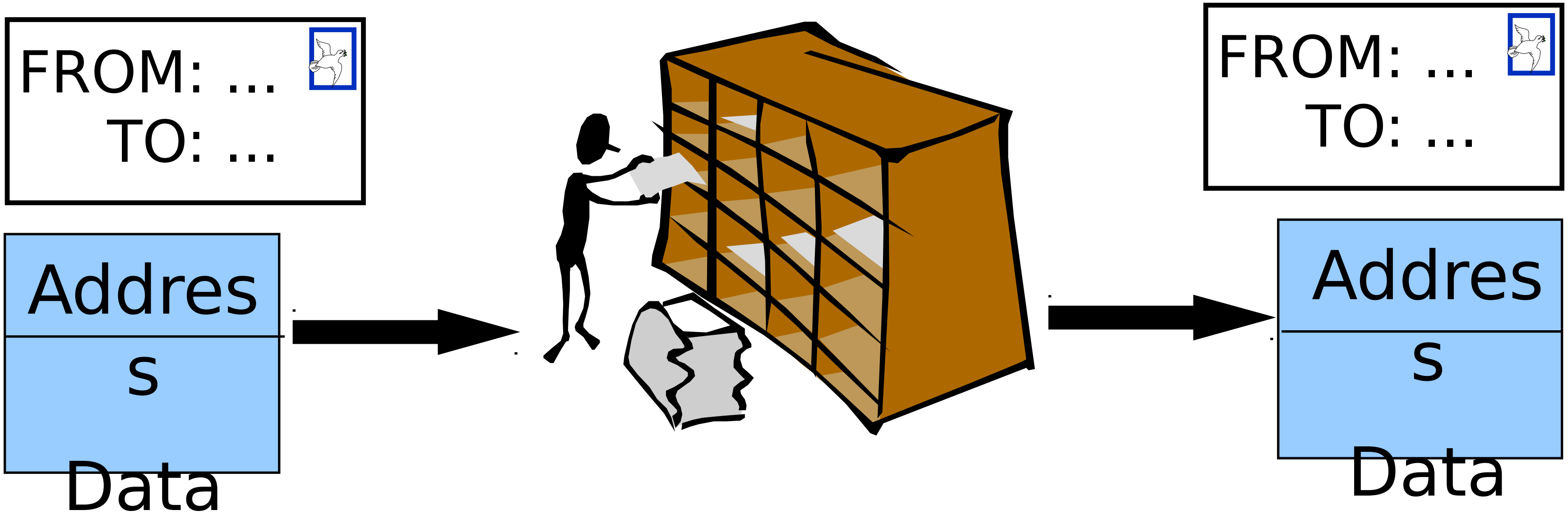
🟧 Capabilities Injected by SmartPackets
🟦 Standard Services Network Node

Environment

- Complex services and large resource sets
- Great variety in application requirements
- Infrastructure is selectively tailored for DoD user needs
- “Just in time” specialization – on demand at time of use

NOT-SO-SMART PACKETS

Static Packets: Network Elements Constrained to Simple Functions



FROM: ...
TO: ...

Addres
s
Data

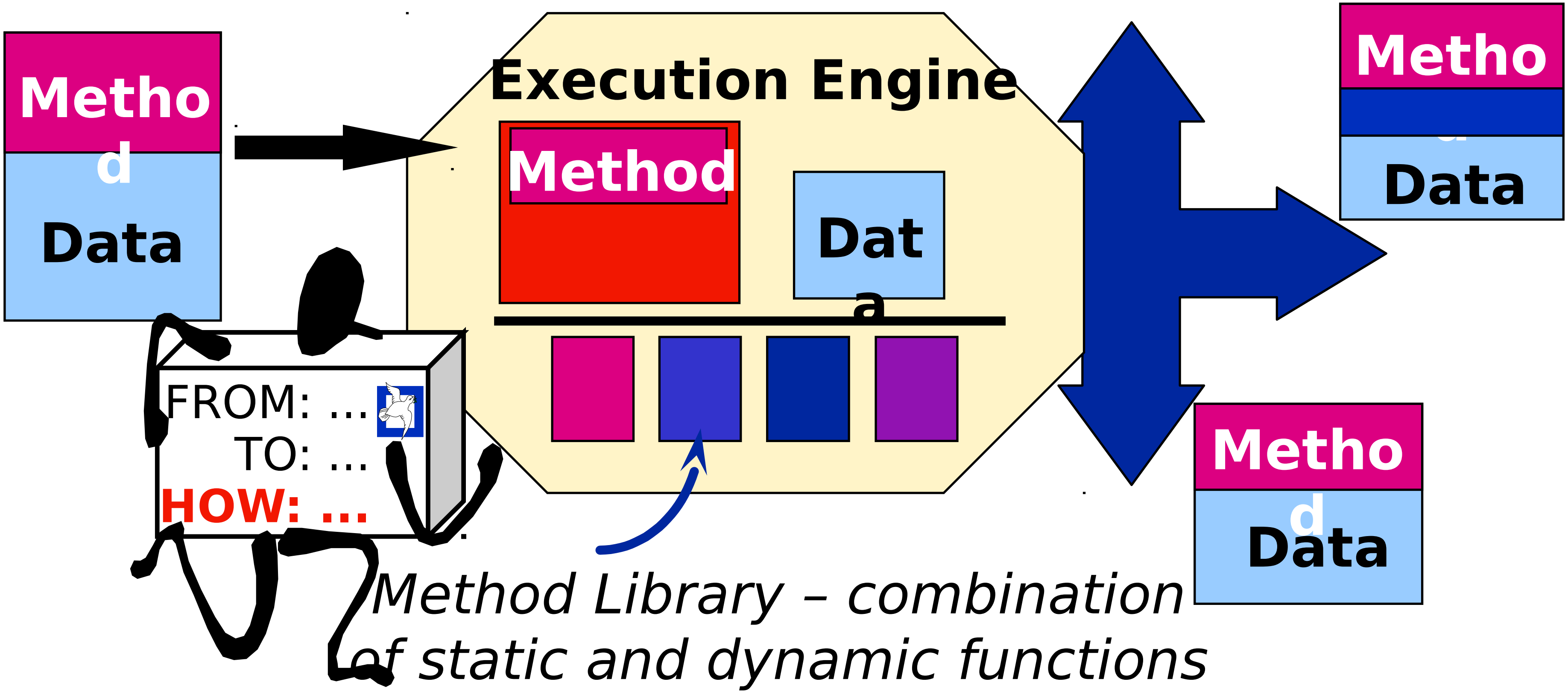
FROM: ...
TO: ...

Addres
s
Data

Apply routing information to address;
forward data

SMARTPACKETS

Active Nodes Use SmartPackets as Software *and* Data



Method Library – combination of static and dynamic functions

GOALS

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Quantifiable Improvement in Network Services

Audio/video synchronization and full-rate video over multicast

GOALS

Quantifiable Improvement in Network Services

- Audio/video synchronization and full-rate video over multicast
- Fewer retransmitted packets, 100% increase in useful data rate to end applications

Architecture Creates Solutions to Future DoD Needs

- e.g., “addressless” networks, resource directed communication

Fault-Tolerance Mechanisms Based in Network

Multi-Tiered Mobile Security

- Authentication forms basis for dynamic access control
- Separate traffic and administrative functions based on

TELECONFERENCING IMPROVEMENTS DURING LIVE SESSIONS

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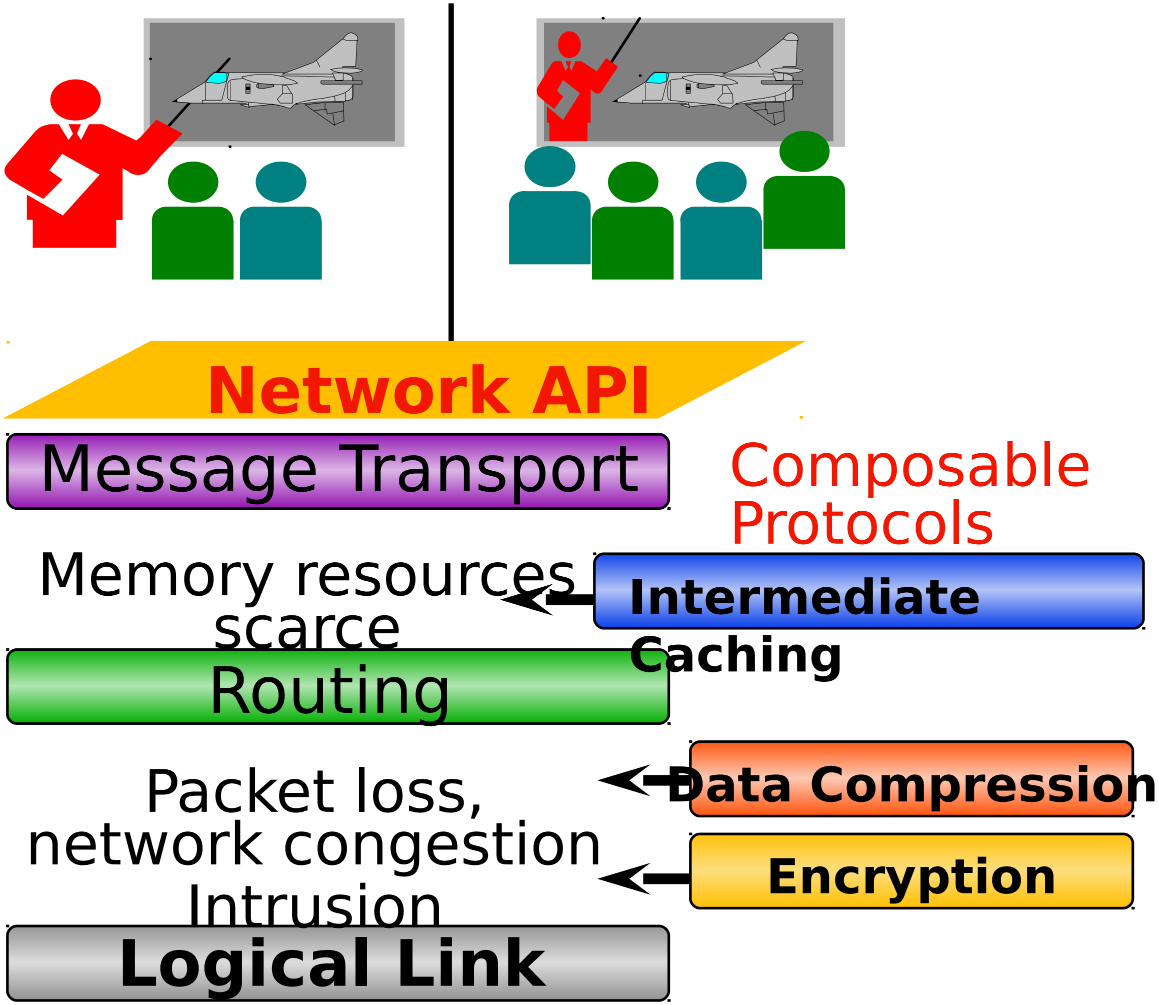


Network API

Message Transport

Composable Protocols

Memory resources scarce

Intermediate Caching

Routing

Packet loss, network congestion

Data Compression

Intrusion

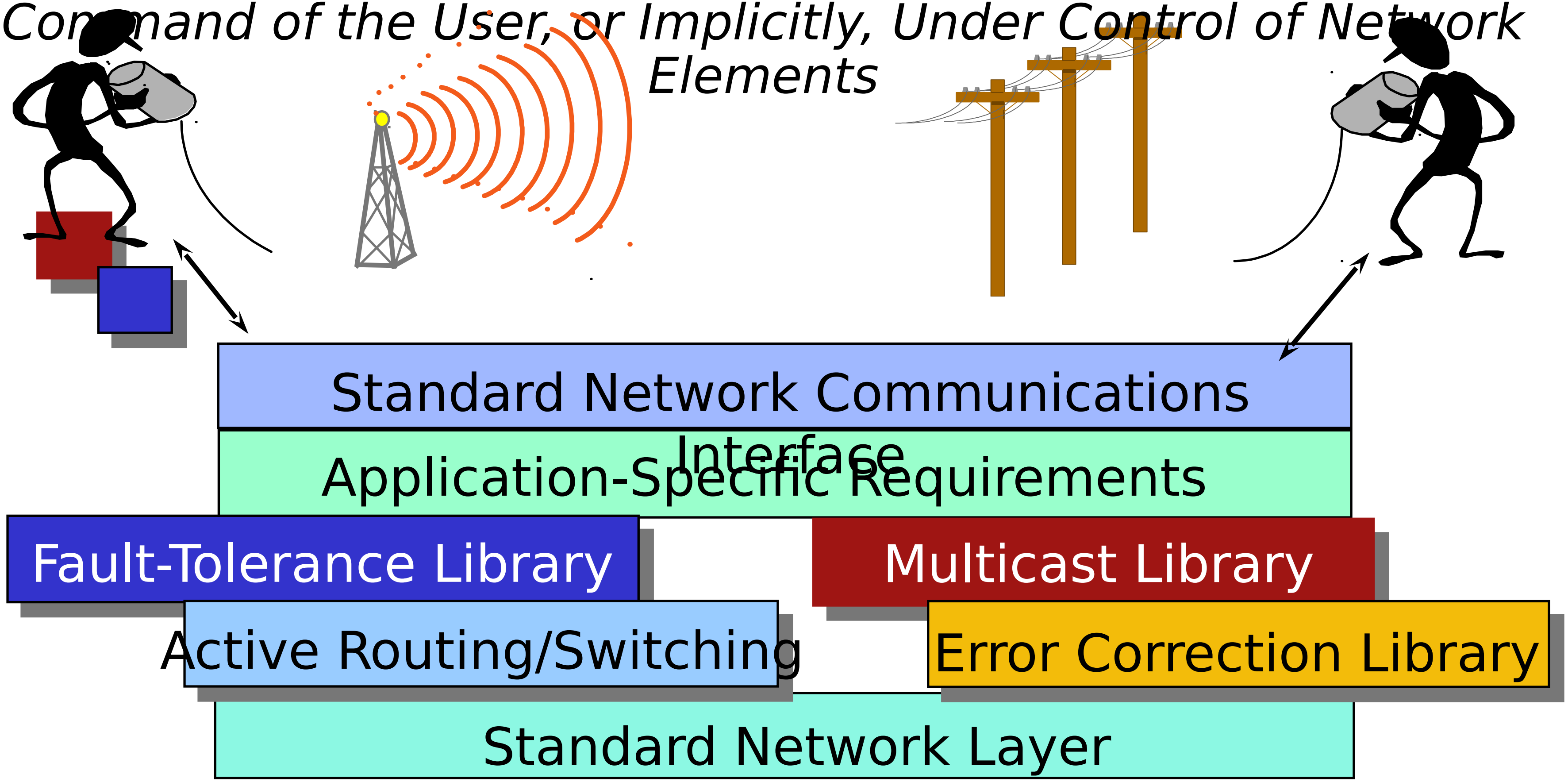
Encryption

Logical Link

- Active Networks Can *Counter Anomalies During Live Sessions*
- The Enhancements Target the Physical *Elements Closest* to the Problem
- Immediate Qualitative Improvements in Teleconferencing Sessions – e.g., Clearer Audio, Smoother Video
- Dynamic Network Security Domains With Strong

COMPOSABLE SERVICE ENHANCEMENTS

Required Modules Move Into Communication Path, Either Directly at Command of the User, or Implicitly, Under Control of Network Elements



Standard Network Communications Interface

Application-Specific Requirements

Fault-Tolerance Library

Multicast Library

Active Routing/Switching

Error Correction Library

Standard Network Layer

NETWORK ATTACK TRACEBACK

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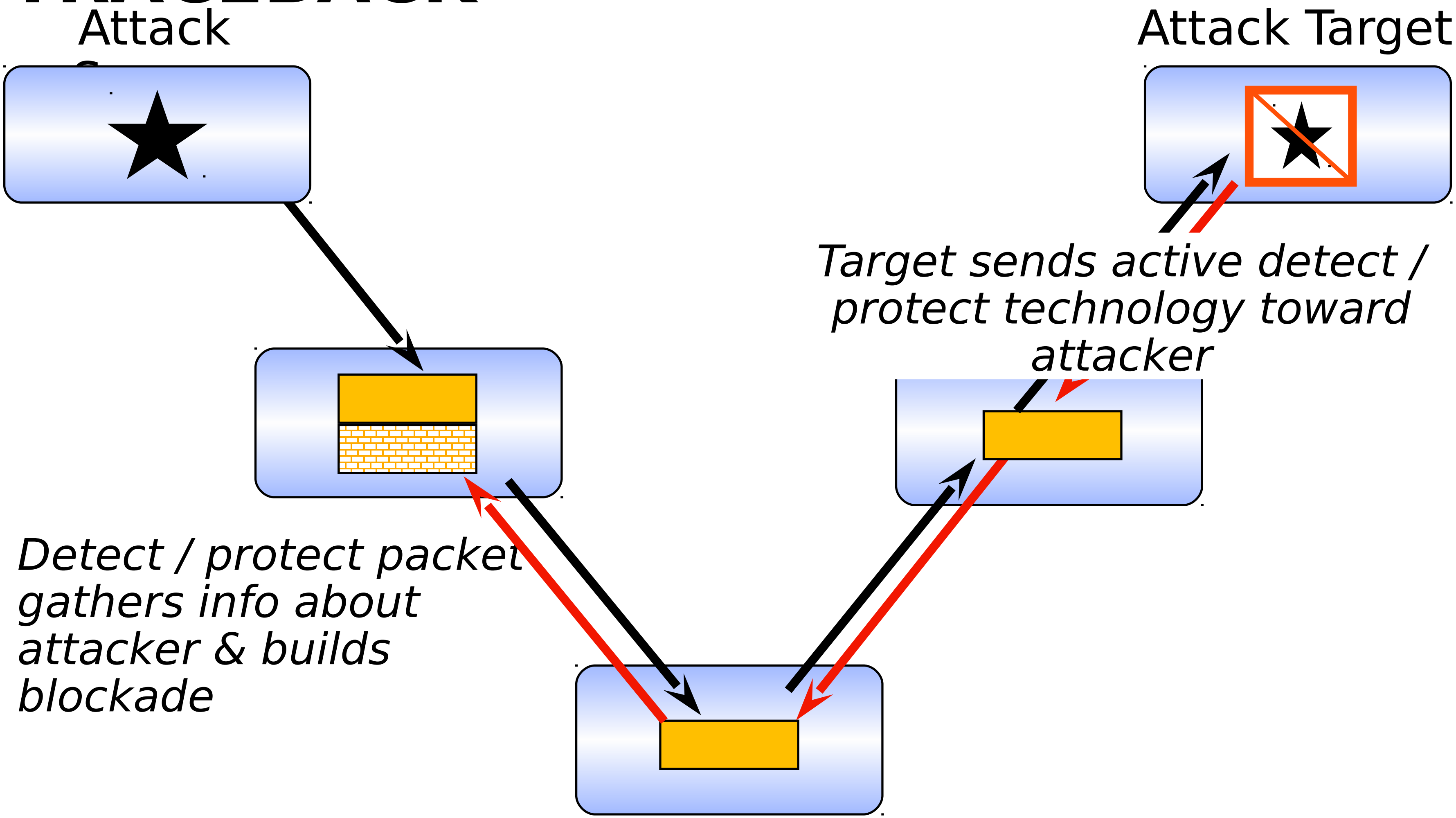


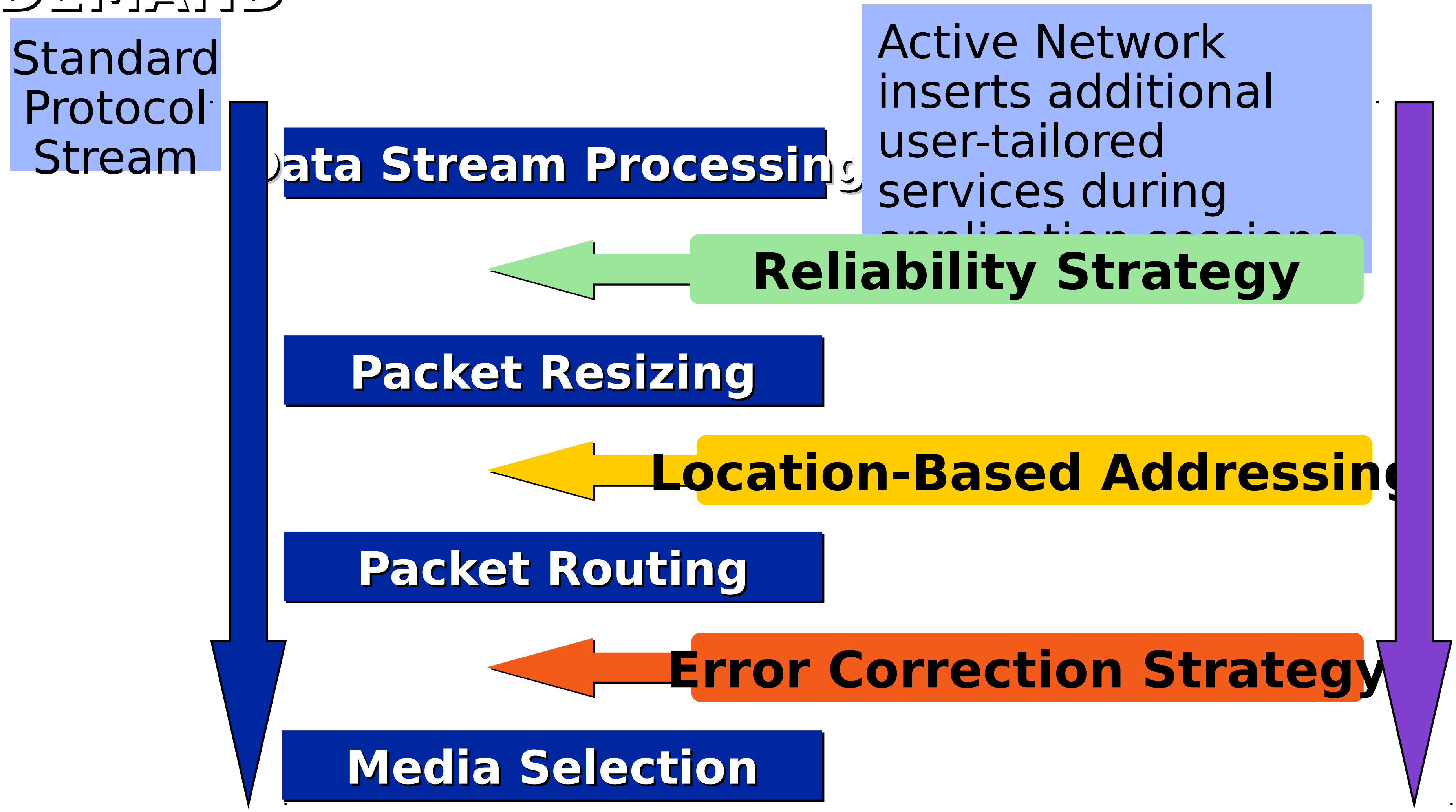
Attack S

Attack Target

Target sends active detect / protect technology toward attacker

Detect / protect packet gathers info about attacker & builds blockade

TAILORED COMMUNICATION ON DEMAND



Standard Protocol Stream

Active Network inserts additional user-tailored services during application sessions

Data Stream Processing

Reliability Strategy

Packet Resizing

Location-Based Addressing

Packet Routing

Error Correction Strategy

Media Selection

SUCCESS CRITERIA / METRICS

Capability	Present	Goal
Active Routers with access controls	Demos with placeholder security	1000 nodes; 3 security models
Dynamic protocol delivery; Modular construction of advanced services	Demo of LAN bridge software reconfiguration	Network protocol reconfiguration "live"
Engineering metrics: Improvements in speeds delivered to applications, memory use, reduced data loss	Applied theoretical results for fault-tolerant communication	Multicast suite and other advanced transport services via modules and verification
	Error reduction possible for audio streams; simulation studies	Order of magnitude improvements in all targeted areas

ARCHITECTURAL FRAMEWORK

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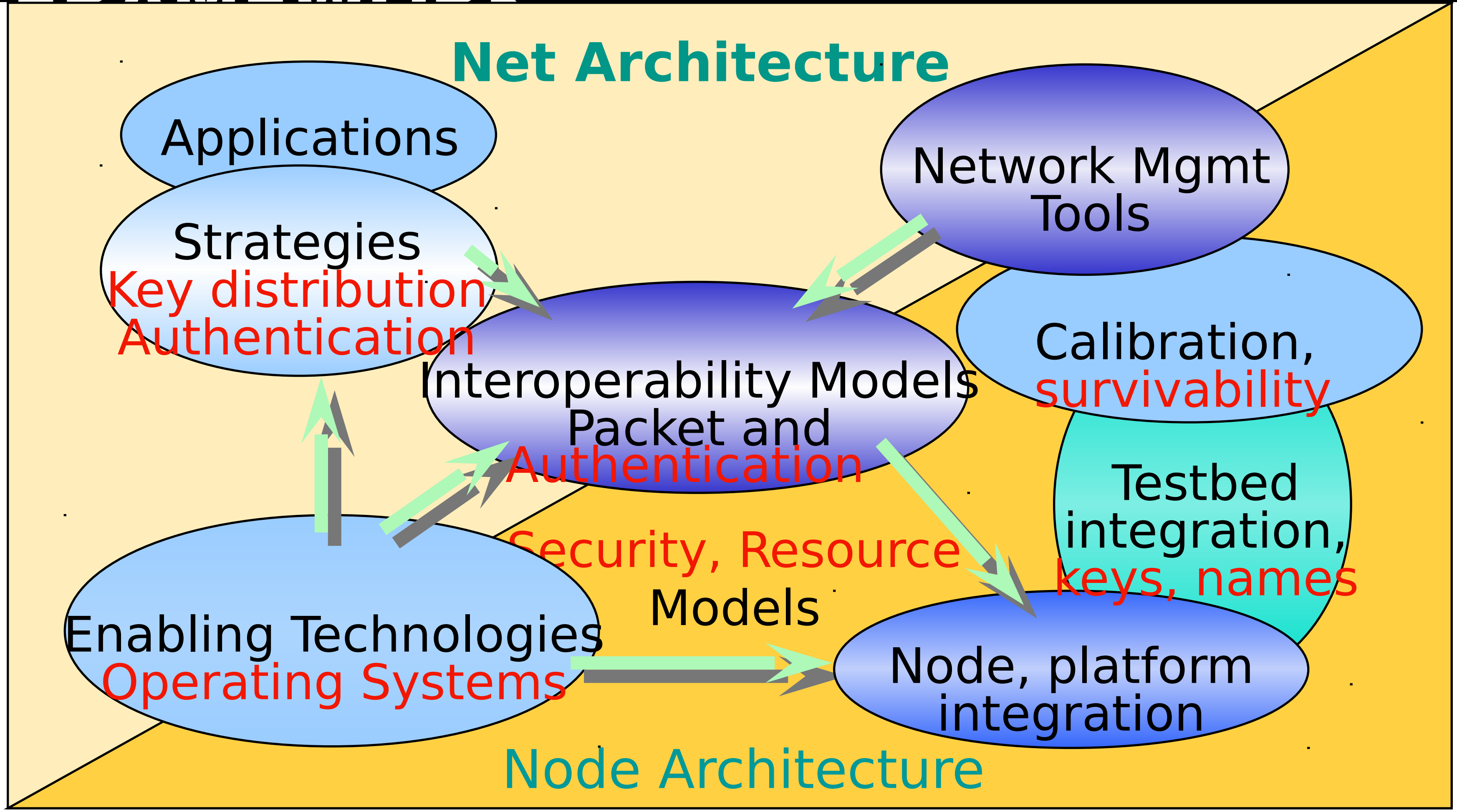


Net Architecture

Applications

Strategies
Key distribution
Authentication

Network Mgmt
Tools

Interoperability Models
Packet and
Authentication

Calibration,
survivability

Testbed
integration,
keys, names

Security, Resource
Models

Enabling Technologies
Operating Systems

Node, platform
integration

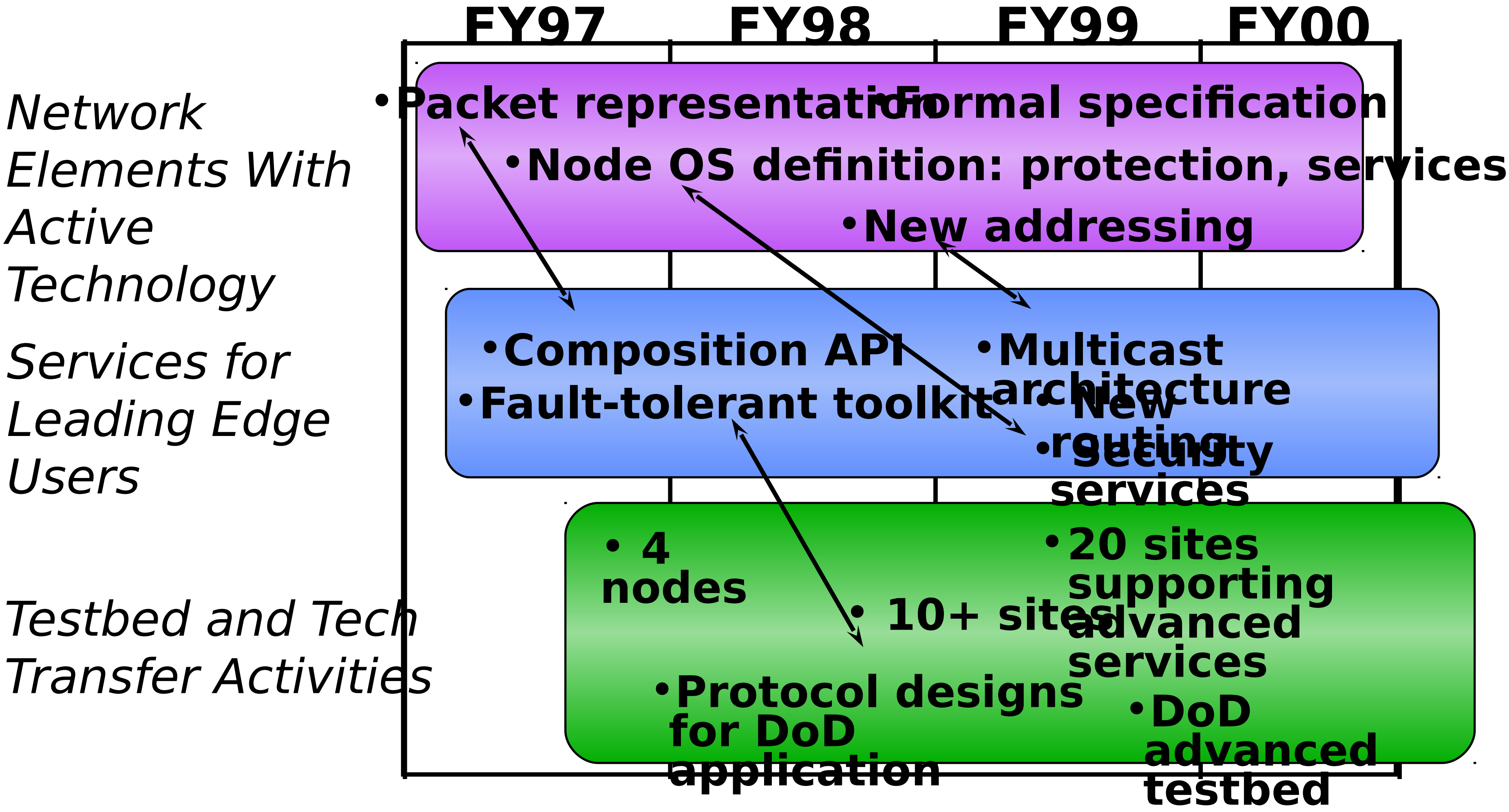
Node Architecture

Security permeates architecture

SECURITY ARCHITECTURE

- Enabling Technologies Support High Assurance Modules
- Interoperability Includes Vetting of Packets
- Node Has Security Model and Set of Policies
- Strategies Include Security Mechanisms
- Applications Have Formal Basis for Security Properties

ROAD MAP



FY97 FY98 FY99 FY00

Network Elements With Active Technology

- Packet representation
- Formal specification
- Node OS definition: protection, services
- New addressing

Services for Leading Edge Users

- Composition API
- Fault-tolerant toolkit
- Multicast architecture
- New routing
- Security services

Testbed and Tech Transfer Activities

- 4 nodes
- 10+ sites
- 20 sites supporting advanced services
- Protocol designs for DoD application
- DoD advanced testbed